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Erwinia amylovora and its control methods- a short review

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ABSTRACT:
Erwinia amylovora is the phyto-pathogenic bacteria which are producing the fire blight to fruiting trees from family Rosaceae. The article review some of the control methods, use of pesticides, of copper based products, of antibiotics and the newest methods- using antagonistic microorganisms including viruses. The new bio-pesticides require still much research, practical work and new legislation in order to support their application.
Key words: fire blight, *Erwinia amylovora*, Rosaceae, orchards , fruiting trees, biological control methods.

INTRODUCTION

The fire blight is produced mainly by the G negative bacteria *Erwinia amylovora,* and some related strains *E. pyrifoliae*, *E. pyriflorinigrans* and *E. uzenensis* [1] possess a genes equipment necessary for their virulence and pathogenity which are the best conserved among strains like *relA*, *dksA* and *csrA/rsmA* [2]. In the condition of climate change, its geographical dissemination in cultures change dramatically [3]. Anyway, this phyto-pathogen has many capacity of adaptation even at lower temperatures [4]. Another problem is its resistance to different pesticides and antibiotics revealed by experiments [5], and streptomycin resistance [6]. A challenge for phyto-pathological services in all the counties is the imported /exported possible infected plant material, commercial fruits transportation over the borders, without a rigorous control as an analysis of a ministry from New Zealand reveals [7]. The transmission of this pathogen, like others phyto-pathogens is performed by agricultural products, biological materials and by some insects like *Ceratitis capitata* [8].

CONTROL METHODS

The virulence system of *E. amylovora* is very complex and requires genes and proteins which contribute to its fitness. Main virulence factors are exo-polysaccharides, biofilm formation, type III secretion system, and their motility [9]. Type III secretion system effectors and proteins of outer membrane are mentioned as virulence factors by Holtappels and coauthors [10] as fighting against host defense. The exo-polysaccharides helps the bacteria to face with all kind of stressors including [11] survival under copper treatment. The HopX1 which functions as virulence protein in apple [12] 2011), and TolC a protein in outer membrane of *E amylovora*, are necessary for virulence and resistance to different stressors [13]. A polyamine amidinotransferase (Hsva, virulence factor) is necessary for systemic infection of *Erwinia amylovora* in apple [14]. In fact, the studies demonstrated that the different strains can be divided in subgroups according their molecular structures of different virulence gene expression like amylovoran production differ in Ea273, Ea110, and CFBP1430 [15].

Pesticides.

Aliette 80 WG (Bayer A.G.) is a fungicide containing fosetyl aluminium which is used against *E. amylovora* in concentration of 0.3% [16] Ridomil MZ Gold 68 WG (3.8% metalaxyl-M and 64%, mancozeb), Miedzian 50 WG (50% copper oxychloride, Euparen Multi 50

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WG (50% tolylfluanid), Captan 80 WG [containing 80% N-(captan)], and Dithane Neotec 75 WG (75% mancozeb) were used in experiments for control of fire blight [17], the most effective against *E amylovora* were fungicides with mancozeb, mancozeb + metalaxyl M, and copper oxychloride.

Copper-based products.

A frequent method for control of *E amylovora* is the use of copper products treatments. This is only a part of solution, because the bacteria mobilize its genetic capability having a different transcriptional profile increasing the expression of 23 genes; in specially copA confer resistance to copper compounds [18].

Other products.

Decapeptides containing tryptophan residues are effective against *E. amylovora*). The best was BPC086W and BPC108W, with a MIC from 0.8 to 12.5 μM [19]. Phenol based plants compounds can acts as Type III secretion system modulators, some of them suppresses this important virulence factor expression [20] and can be a solution in the fight against this pathogen. Prohexadione Calcium is a shoots growth regulator which can reduce the incidence of the fire blight, comparing with paclobutazol, and with non treated variant [21].

Natural origin product can be used in the control of fire blight, for example juglone extract which have a bactericidal effect [22]. Leaves of cultivars of *Malus, Cydonia* and *Pyrus* sp. were soaked in extracts of *Citrus maxima* (essential oil), and then infected with *Erwinia amylovora* culture, the results showed that the extract inhibits the biofilm formation, in special on *Cydonia* leaves [23]. Romanian researches revealed, after testing some pesticides and plants extracts, that, the highest activity against *E. amylovora* has Alcupral 50 PU, containing copper oxychloride, and extracts of *Pelargonium odoratissimum* and *Ocimum basilicum* had a good antibacterial activity [24]. Some Polish researchers [17]showed that from many tested essential oils from lavender, sage, cloves, lemon balm and thyme, the most effective were sage, thyme, and cloves essential oils.

Antibiotics.

Modern procedures were tested for example to injects trunks in xylem streptomycin, acil-benzol- ar-S-methyl and potassium phosphytes which results in reduction of severity of disease, in the same time injection with oxytetracycline was effective [5]. Of course this method is very difficult to apply to large orchards, and is not economic (authors opinion). Kasugamycin (Kasumin 2L) used in orchards against *Erwinia*, reduces 100 fold the population of culturable bacteria [25], but some kasugamycin resistant bacteria exist due to mutations in ksgA genes.

Antagonists.

Using antagonistic microorganisms can be a solution to the problem. A strain *Pseudomonas fluorescens* EPS62e was used to control *E. amylovora* [26]. Antagonistic bacteria as *Pseudomonas orientalis* F9, can be used against phytopathogens including *Erwinia* [27]. *Pantotea agglomerans* strain E 325 is used in formulations against fire blight, being able to suppress growth on apple blossoms stigmas [28].

Using a mixture of biological control agents is a better solution, but in some cases, combinations of *Pseudomonas fluorescens*

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A506, combined with *Pantoea vagans* strain C9-1 or *Pantoea agglomerans* strain Eh252, efficacy are not optimal because the protease of Pf. A506 which are degrading the peptide antibiotic secreted by Pv C9.Thats why compatible mixtures of strains must be used [29]. The mixture of *Pseudomonas fluorescens* A506 and *Pantoea vagans* C9-1 have a less effect than the individual strains application due to some difference in the mechanisms of disease suppression [30].

Other authors, used some isolates from pear trees and tested them for antagonistic activity against *Erwinia* [31]. The strains were *Pseudomonas* sp. (Ps 170, Ps. 117), *Pantotea agglomerans* (Pa. 21) and *Enterobacter* sp. (En. 113) which can be used as antagonists in pears orchards. Ps170 are able to produce antibiotics like pyrrolnitrin and pyoluteorin. "Actinovate" bio-pesticide contains *Streptomyces lydicus* as active product [32].

The use of bacteriophages to control phytopathogenic bacteria is discussed by Born and collaborators [33]. Their genetic modification is possible in order to fits better to this task. A description and properties of several bacteriophages which can be use against phytopatogenic bacteria was described (2011) [34]. AgriPhage™-Fire Blight and AgriPhage™ were recently issued as commercial products [35].

CONCLUSIONS

The fire blight is a very serious disease of *Rosaceae* which can destroy period entire orchards. There are several methods of control, from physical methods, to pesticides and biological control. In the near future, the biological control will be a good choice, being not harmful for men and environment. New researches, methods, legislations must be issued in oder to control this dangerous phyto-pathogen and its spread in the world. The issue of new bio-pesticides must be accompanied by standards and legislation regarding safety of their use.

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